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Bimonthly Progress Report for
1 September to 1 November 1962

THERMOELECTRIC MATERIALS

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I INTRODUCTION

This Progress Report describes the work performed under Contract NObs-77017 (Index Number NS 058-001) on thermoelectric materials for the period 1 September to 1 November 1962 and outlines the proposed effort for the next period.

II WORK PERFORMED

Cuprous Sulfide -- A few measurements have been made to determine the Seebeck coefficient and resistivity of molten cuprous sulfide under one atmosphere sulfur pressure. The procedure used involved loading the conventional U-tube, fitted with a sulfur reservoir, with powdered cuprous sulfide, evacuating the system and sealing it under vacuum. The sulfur reservoir was raised to the boiling point of sulfur to supply one atmosphere of sulfur pressure in the system and the furnace temperature was raised to melt the charge.

The Seebeck coefficient was found to be + 165 $\mu v/^{o}C$ in the vicinity of $1100^{o}C$ and the resistivity was determined to be about 2.5×10^{-3} Ω^{-} cm at the same temperature. Only four points were determined before contact between the probes was lost and the run was discontinued. After removal of the sample from the furnace a bubble was found to have been formed around one of the probes and held in position by the configuration of the quartz tube.

The Seebeck coefficient is considerably less than that observed previously for this composition (Report No. 15) indicating the need for further exploration of this system before a conclusion can be drawn about its usefulness in power generation applications. These values for the Seebeck coefficient and resistivity result in a calculated α^2/ρ of $\sim 19 \times 10^{-6}$ which is lower than the value expected from this system, but about the same as that calculated for 75 mol % Cu_2Te + 25 mol % Cu_2S (shown in Fig. 4, Summary Report).

Cuprous Sulfide - Ferrous Sulfide -- Measurements of the Seebeck coefficient and resistivity of a composition containing 50-50 mol % Cu_2S + FeS were made in a conventional quartz U-tube under flowing helium atmosphere. Seebeck coefficient values were obtained from 1200 to 700°C but difficulties with contact between the probes and the charges allowed only a few determinations of the resistivity. The data obtained are presented in Table I. The Seebeck coefficient values are referred to platinum although graphite was used to contact the melt.

The values for the Seebeck coefficient and resistivity do not make this composition attractive for power generation applications, but the possibility of a shift from a p-type to n-type conductor at lower temperatures is of interest in the understanding of these systems.

III WORK PLANNED 1 NOVEMBER 1962 TO 1 JANUARY 1963

Examination of other sulfide mixtures will be continued with the objective of obtaining general information on the effect of compositional changes on the Seebeck coefficient and resistivity.

IV CONTRIBUTORS

Mr. G. Withers and Dr. J. W. Johnson performed all experimental work described in this report.

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Table I

SEEBECK COEFFICIENT AND RESISTIVITY FOR

50 - 50 mol % Cu_2S + FeS

Temp (°C)	Seebeck Coefficient ($\mu v/°C$)	Temp (°C)	Resistivity (Ω^- cm)
1099	+70	1095	4.57×10^{-3}
1104	+67	1135	4.96×10^{-3}
1141	+72	1198	4.83×10^{-3}
1204	+74	Contact Lost Between Probes	
1208	+77		
1105	+74		
1064	+64		
1041	+68		
1012	+43		
963	+36		
905	+25		
854	+19		
809	+11		
714	+ 8		